EMFAC2002 Training

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California Air Resources Board
Planning and Technical Support Division

Introductions & Agenda

- Mark Carlock, *Chief, Mobile Source AB (mcarlock@arb.ca.gov)*
  - Jeff Long, *Manager, Analysis Section (jlong@arb.ca.gov)*
  - **Dilip Patel**, *Programming Coordinator (dpatel@arb.ca.gov)*
- **Website**: *http://www.arb.ca.gov/msei/msei.htm*
  - On-Road link
- **AGENDA-** *summary*
  1) Introduction to EMFAC2002
  2) Overview of Burden/Emfac/Calimfac modes
  3) Editing fundamental data
  4) Examples
  5) New features
  6) User's Forum
  7) Q & A

What is EMFAC2002?

- **Computer model** *that calculates emission inventories for pollutants from motor vehicles operating* ***on-roads*** *in CA.*
- **EMFAC2002 version 2.2** *(latest)*
- **Emission Inventory = Emission Factor * Activity**

  Emission Factor
  - *(gm/mi or gm/hr or gm/start)*

  Activity
  - *(starts/miles/speed/soaks)*

  Both vary by vehicle population which varies by *(geographic area/class/fuel/age)*

Pollutants and Processes

- **Pollutants**
  - HC / CO / NOx / PM / CO2 / LEAD / SOx
  - HC = ROG / TOG / CH4
  - PM = TOTAL / PM10 / PM2.5
- **Processes (Exhaust)**
  - RUNNING EXHAUST
  - START EMISSIONS (*gasoline fueled vehicles)*
  - IDLE EMISSIONS *(light-heavy to heavy-heavy trucks & school buses)*
- **Processes (Evaporative)**
  - RUNNING LOSSES
  - HOT SOAK
  - DIURNAL
  - RESTING LOSSES
- **Tire Wear / Brake Wear**

System Requirements / Installation

- **Executable -** http://www.arb.ca.gov/msei/msei.htm
- **Windows 95 plus**, *including windows NT*
- **40 MB of Hard Disk** space
- **Minimum** 64 MB Ram
- **Virtual Memory** 300 MB - *on windows 95 and 98*
- **Install -** *default install will overwrite previously installed versions if they were installed in the "c:/Program Files/Emfac2000 " folder.*

Terminology - Vehicle Classes

Vehicle Class	Fuel Type	Code	Description	Weight Class	Abbr.
1	All*	PC	Passenger Cars	All	LDA
2	All*	T1	Light-Duty Trucks	0-3750	LDT1
3	Gas, Diesel	T2	Light-Duty Trucks	3751-5750	LDT2
4	Gas, Diesel	T3	Medium-Duty Trucks	5751-8500	MDV
5	Gas, Diesel	T4	Light-Heavy-Duty Trucks	8501-10000	LHDT1
6	Gas, Diesel	T5	Light-Heavy-Duty Trucks	10001-14000	LHDT2
7	Gas, Diesel	T6	Medium-Heavy-Duty Truck	14001-33000	MHDT
8	Gas, Diesel	T7	Heavy-Heavy-Duty Trucks	33001-60000	HHDT
9	Gas, Diesel	T8	Line-Haul Vehicles	60001+	LHV
10	Diesel	UB	Urban Buses	All	UB
11	Gas	MC	Motorcycles	All	MCY
12	Gas, Diesel	SB	School Buses	All	SBUS
13	Gas, Diesel	MH	Motor Homes	All	MH

All* = Gas /Diesel / Electric

Terminology (-cont.-)

- **Technology Group** - *vehicle groupings based on either similar emission control technologies, standards or in-use deterioration rates.*
- **Model Year** - *model calculates emission rates for 1965 to 2040 model years. For each vehicle class, each model year is represented by a combination of technology groups.* ***(-phase-in schedules.)***
- **Calendar Years** - *inventories for 1970 - 2040*
- **Activity**

  - Population *from DMV, forecast and backcast from 1999*

  - Vehicle Miles Traveled (VMT) *from regional estimates of VMT. These VMT estimates matched by modifying either or both the vehicle population and accrual rates.*

  - Trips per day

Basic Scenario Data

- **Geographic Area** *69 unique areas resulting from 15 Air Basins, 35 Air Pollution Control Districts and 58 counties.*

  - **Method** *Simple average or "do-each-sub-area". Accuracy vs. speed (IM)!*

- **Calendar Year**

- **Month / Season** *12 months plus summer (ozone), winter (CO) and annual average. Temperature, Relative Humidity, Fuel RVP vary by month.*

- **Model Year Range** *45 model years. Can calculate model year specific contributions.*

- **Inspection And Maintenance**

- **Single scenario / multiple scenario / multiple WIS**

User Interface

- **Starting the program** *emfac console window*
- **File Menu** *file new/open , run and help*
- **MAIN screen**
  - *scenario list, add new scenario vs. edit scenario*
  - *save vs. save as*
- **Scenario 1** *geographic area, calendar year and season*
- **Scenario 2**
  - *Scenario title (echo)*
  - *Model Years*
  - *I / M Options*
- **Mode and Output**
  - *Burden / Emfac / Calimfac*
  - *Output frequency*
  - *Pollutants*

Burden

- **Tons per day**

Option on Input Form (Report Type)	Filename Extension Used
Planning Inventory	BUR
Heavy-Duty Detail (Planning Inventory Detail)	BUR
Text File (CSV) (Planning Inventory Spreadsheet)	CSV
MVEI7G CSV File (Planning Inventory Database)	BCD

- **Examples / Outputs**
  - South Coast Air Basin simple average run for 2010 ***(Ex1& Ex2)***
  - South Coast Air Basin sub-area run for 2010 ***(Ex3)***
  - South Coast Air Basin simple average hourly run ***(Ex4)***
  - Multi Area (*SCAB/State)* simple average run for 2010 ***(Ex5)***
- **Weight output**

Emfac

- **Emission Factors** *(grams per hour or grams per mile). For each temperature (-20oF to 120oF), relative humidity (0-100%) and speed (0 - 65 mph) combination.*

Option on Input Form	Filename Extension Used
Binary Impacts	BIN
ASCII Impacts	ERP
Rate Summary	RTS
Impact Rate Detail	RTL

- **DTIM / URBEMIS**
- **Idle Rate**
- **Example**

  - SCAB simple average 2010, T=75^{o}F, Rhum= 40% & all speeds ***(Ex6)***

Calimfac

- **Specialized** runs

Option on Input Form	Extension	Description
Emission Factors without IM Emission Factors with IM I/M Credits Technology Group Detail	*.OUT & *.CYW	Zm and Drs by model year for each vehicle class, process and pollutant. Calendar Year specific weighted emissions by vehicle class
Regime Growth Rates	*.RG1 *.RG2 *.RG3 *.RG4 *.RG5 *.RG6	HC Regime Growth Rates w/o I/M CO Regime Growth Rates w/o I/M NOx Regime Growth Rates w/o I/M HC Regime Growth Rates with I/M CO Regime Growth Rates with I/M NOx Regime Growth Rates with I/M
Model Year Em Rates	*.MY1 *.MY2	W/O I/M rates by MY and age With I/M rates by MY and age

- **Example** run / output

  - SCAB simple average 2010, FTP weighted with full corrections ***(Ex7)***

Editing Fundamental Data - Tech / IM

! **SEQUENCE** of edits
Single scenario model

- **Exhaust Technology Fraction**
  - *Apply to model year / model year range*
  - *Apply to other vehicle classes*
  - *Technology specific*
- **Evaporative Technology Fractions**
  - *Gasoline only*
  - *Apply same ZEV fraction*
- **Interim I/M**
  - *Difference between SIP and interim cutpoints*
  - *ARB internal use*

Editing Fundamental Data - Activity

! **SEQUENCE** of edits
Edits applied proportionally

- **Population**
  - *Edits applied proportionally*
  - *Edits by vehicle, fuel, and age*
  - *Age distributions*
- **Accrual** (defn.) *annual miles driven*
  - *Population weighted accrual rates*
  - *Edits by vehicle class, fuel and age*
- **Trips** *based on the number of engine on to off events*
  - *Edits by vehicle class, fuel and hour (hourly model!)*
  - *Santa Barbara*
- **VMT** *from regional planning organizations*
  - *Edits by vehicle class, fuel and hour*

Editing Fundamental Data - Profile/Speeds

- **RVP** *(fuel reformulation)*
- **Episodic Days**
  - **TEMPERATURE** *(specific ozone day)*
  - **RELATIVE HUMIDITY** *(specific ozone day)*
- **Speed Fractions**
  - *Edits by vehicle class, hour and speed bin*
  - *Apply changes to this hour / vehicle class*
  - *Apply to others*
- **Idle Time**
  - *Edits by vehicle class, fuel and hour*
  - *Effect on Burden (tons/day) and not Emfac (grams/hour)*

Examples (1)

- **Inspection & Maintenance**

  SFAB 2010 CY, added enhanced ASM testing beginning 2004 ***(Ex8)***
  SCAB 2010 CY, eliminate exemption for older vehicles in 2005 ***(Ex9)***
  SCAB 2010 CY, above plus tighter cutpoints ***(Ex10)***
  SVAB NO I&M, modeling no I&M for benefit purposes ***(Ex11)***

- **Changing VMT**

  - Recommended methods for using EMFAC2000 for emission budgets and assessing conformity. http://www.arb.ca.gov/planning /sip/emfac2002/emfac2002.htm

  - Population * Accrual rate = VMT
  - *To maintain this relationship calculate new population*
    New_Pop = (New_VMT / Old_VMT) * Def_Pop
  - *Matches new VMT, and increases the number of trips.*

  SCAB 2006 CY, increase VMT in Riverside and San Bernardino counties. ***(Ex12)***

Examples (2)

- **Trips**
  - *Santa Barbara trip change (hourly)*
  - *Should VMT also change ? (depends)* ***(Ex13a and Ex13b)***
- **Speed Distributions**
  - *Percent of VMT by speed and by hour*
  - *Heavy Duty Truck model and new speed estimates* ***(Ex14a)***
  - *Changing the time HHDV spend idling* ***(Ex14b)***
- **Phase-In Schedules**
  - *Increasing the fraction of ZEVs* ***(Ex15)***
- **Lifetime Emissions** (*50% useful life or standards)*
  - *ULEV, 100% TG & run burden by model year. Per vehicle*
  - *CALIMFAC (*.OUT) not recommended* ***(Ex16)***

Examples (3)

- **Retrofit programs**
  - *Given calendar year, run by model year (45 scenarios)*
  - *Apply percent reduction to affected model years.* ***(Ex17)***

Planned Features

- **Technology Group**
  - *Tech group id strings*
  - *Modify dialogs to use the id strings*
  - *link exhaust and evaporative technology group (Warning dialog)*
  - *Portable Tech fractions. Apply TG changes to other areas*
- **Apply Vs. Done** *(confusing for TG dialog)*
- **Model Execution**
  - *Run by vehicle class or technology group*
  - *Loop over given calendar years and model years. (outputs)*
- **Copy / Paste**
  - *Copy to Excel via clipboard and paste from Excel via clipboard*
- **CEIDARS / CEFS**
- **Log File**

User Input

- *Additional features that **users** would like.*